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FOREST RESEARCH NOTES

CALIFORNIA FOREST AND RANGE EXPERIMENT STATION

FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE
IN COOPERATION WITH THE UNIVERSITY OF CALIFORNIA
BERKELEY

Research Note No. 20 April 25, 1939

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REDWOOD LOGGING COSTS IN MENDOCINO COUNTY

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Some progress has been made in the determination of net conversion values for redwood trees 1/ and a rough form of economic selection is being practiced by several redwood operators. It seems very probable, however, on the basis of general observation and the results of studies already completed that in Mendocino County, in particular, many trees are being cut which will not return the cost of logging and milling. This practice reduces the profits of the operator and needlessly removes trees which if left standing would be of distinct value as seed trees for the regeneration of the cut-over areas and as the basis for an early return cut. A complete logging and milling study is therefore needed to make possible tree selection which will give maximum returns to the operator.

In anticipation of such an investigation time studies of the various steps in woods operations in Mendocino County have been carried on by the California Forest and Range Experiment Station during the past few years. Preliminary results of these studies are being made available at this time because it may be several years before the complete study can be undertaken.

FELLING

The analysis of felling time for 130 sound and 31 goosepen redwoods by tree diameter, shown in table 1, gives for sound redwood the time per tree for the different items including total time, and for goosepen trees (trees with butts hollowed out by fire and decay) the total time only.

1/ Research Note No. 17 by M. R. Brundage, California Forest and Range Experiment Station.

2/ Assistance in the preparation of these materials was furnished by the personnel of Works Progress Administration Official Project Number 765-08-3-16.

Table 1.- Redwood felling time

Diameter O.B. [1]	Sound redwood: Sawing and undercutting	Layout	Swamping	Staging	Wedging	Rest	Move	Barking	Delays [2]	Total	Goosepen trees: Total
Inches	Time in Minutes Curve values										
20	16.5	.0	2.4	1.0	.0	17.2	5.0	.45	3.9	46.4	
25	26.4	2.1	3.0	2.8	.0	17.2	5.0	.45	5.2	62.1	
30	37.2	5.0	3.6	4.6	3.1	17.2	5.0	.45	7.0	83.1	61.7
35	50.0	8.0	4.2	6.4	7.1	17.3	5.0	.45	9.0	107.4	96.3
40	69.2	11.0	4.8	8.3	11.0	17.8	5.0	.45	11.7	139.2	120.3
45	95.0	14.8	5.4	10.2	15.0	18.1	5.0	.45	15.0	178.9	138.7
50	125.6	19.0	6.0	12.1	19.0	20.1	5.0	.45	19.1	226.3	151.8
55	159.2	27.2	6.6	14.0	23.0	27.1	5.0	.45	24.2	286.7	163.6
60	194.8	45.0	7.1	16.0	27.0	36.0	5.0	.45	30.4	361.7	174.9
65	231.7	77.2	7.7	17.9	31.0	46.5	5.0	.45	38.4	455.8	186.5
70	270.0	115.5	8.3	19.8	35.0	58.2	5.0	.45	47.1	559.3	197.6
75	309.0	157.3	8.9	21.8	39.0	70.6	5.0	.45	56.3	668.3	208.5
80	348.8	200.6	9.4	23.7	43.0	83.3	5.0	.45	65.7	779.9	
85	390.0	251.2	10.0	25.7	47.0	96.2	5.0	.45	76.0	901.6	

1/ Diameter outside bark 20 feet above ground on upper side of tree; diameter for redwood is used at this point to get above large butt swell and irregularities at base of tree.

2/ Delays were prorated to trees as a flat percentage of the total time excluding delays.

The redwood felling costs shown in table 2, have the same general trend as do most other felling costs. The real significance of the high cost for the small trees, however, cannot be indicated until all the other costs and the value of the lumber produced is determined.

Table 2.- Redwood felling cost

	Sound redwood			Goosepen Trees		
20 ft. diameter O.B.	Volume 1/	Cost per tree 2/	Cost per M	Volume	Cost per tree 3/	Cost per M
Inches	Bd. ft.	Dollars	Dollars	Bd. ft.	Dollars	Dollars
20	190	$ .85	$ 4.474		$	$
25	700	1.14	1.629	700	.44	.628
30	1380	1.53	1.109	1380	1.14	.826
35	2200	1.99	.904	2110	1.77	.839
40	3250	2.56	.788	2890	2.21	.765
45	4590	3.28	.714	3720	2.54	.683
50	6090	4.16	.683	4890	2.80	.573
55	7630	5.15	.675	6240	3.02	.484
60	9490	6.62	.698	7740	3.22	.416
65	11810	8.37	.707	9330	3.42	.366
70	14490	10.30	.711	10950	3.62	.330
75	17330	12.29	.709	12620	3.83	.303
80	20450	14.35	.702	14310	4.01	.280
85	23690	16.60	.701	16010	4.20	.262
90	27290	18.86	.691	17750	4.37	.246
95	31300	21.15	.676	19530	4.54	.232
100	35530	23.42	.659	21310	4.72	.221

1/ Gross Spaulding - Scaled in logs as bucked. (Logs over 22 feet scaled as two).

2/ Extension of cost curve above 85 inches.

3/ Extension of cost curve below 30 inches and above 75 inches.

Cost per minute $.0184

BUCKING

The results of the analysis of the bucking time data for 227 cuts are shown in table 3.

Table 3.- Redwood log bucking, hand sawing

Log d.i.b.	Log volume[3] Gross Spaulding	Log volume[3] Humboldt scale	Time per M[2] Gross Spaulding Peeled	Time per M[2] Gross Spaulding Unpeeled	Cost per M[1] Gross Spaulding Peeled	Cost per M[1] Gross Spaulding Unpeeled	Cost per M[1] Humboldt scale Peeled	Cost per M[1] Humboldt scale Unpeeled
Inches	Feet B.M.	Feet B.M.	Minutes	Minutes	Dollars	Dollars	Dollars	Dollars
15	480	336	12.71	24.58	.229	.442	.327	.631
20	840	588	14.29	19.05	.257	.343	.367	.490
25	1210	847	15.45	17.69	.278	.318	.397	.454
30	1585	1110	16.53	18.23	.298	.328	.426	.469
35	1970	1379	17.56	19.59	.316	.353	.451	.504
40	2360	1652	18.73	21.57	.337	.388	.481	.554
45	2785	1950	19.61	23.59	.353	.425	.504	.607
50	3245	2272	20.25	25.70	.364	.463	.520	.661
55	3720	2604	20.73	28.04	.373	.505	.533	.721
60	4200	2940	21.19	30.17	.381	.543	.544	.776
65	4680	3276	21.56	32.09	.388	.578	.554	.826
70	5170	3619	21.90	33.83	.394	.609	.563	.870
75	5660	3962	22.23	35.44	.400	.638	.571	.911
80	6170	4319	22.46	36.87	.404	.664	.577	.949

1/ Cost per minute - $0.018.

2/ Includes prorata time for extra cuts for cull portions of tree.

3/ Curved volume of logs in study.

Contrary to what might be expected, the cost and time per M increases with increase in diameter except for the 15 and 20-inch classes of unpeeled logs. This difference from the usual conditions is due in part to a decrease in log length and to an increase in care and time spent in blocking up logs to prevent splitting as the diameter increases.

The greater time for the unpeeled logs over peeled logs is due to the thick bark which must be sawn or chopped away and to difficulties caused by loosened slabs of bark.

In the redwood region the bark is peeled from all logs before they are sawn in the mill and, with the exception of one company, this peeling is done in the woods either before or after bucking. In the past logs were peeled, then burned and finally bucked. With the introduction of tractors, peeling was done quite extensively after bucking and the burning after yarding. At the present time bucking is done before and after peeling as well as before and after burning. In the area studied, bucking of both peeled and unpeeled trees was done after burning.

The cost of bucking by tree diameter is shown in table 4.

The time per cut and the prorata tree time which is shown in table 5, can be used in building up tree costs if other data on the break-up of trees into logs are available.

Table 4.- Redwood log bucking, hand sawing.
Tree costs.

20 ft. diameter O.B.	Sound redwood					Goosepen trees				
		Peeled		Unpeeled			Peeled		Unpeeled	
	Volume 1/	Tree cost	Cost per M	Tree cost	Cost per M	Volume 1/	Tree cost	Cost per M	Tree cost	Cost per M
Inches	Bd.ft.	Dollars	Dollars	Dollars	Dollars	Bd.ft.	Dollars	Dollars	Dollars	Dollars
20	190	.03	.158	.10	.526					
25	700	.16	.229	.25	.357	700	.32	.457	.52	.743
30	1380	.37	.268	.47	.341	1380	.51	.370	.68	.493
35	2200	.63	.286	.75	.341	2110	.72	.341	.86	.408
40	3250	.97	.298	1.11	.342	2890	.98	.339	1.10	.381
45	4590	1.45	.316	1.65	.359	3720	1.33	.358	1.49	.400
50	6090	2.00	.328	2.32	.381	4890	1.81	.370	2.12	.434
55	7630	2.64	.346	3.07	.402	6240	2.48	.397	2.97	.476
60	9490	3.33	.351	3.96	.417	7740	3.10	.400	3.71	.479
65	11810	4.18	.354	5.15	.436	9330	3.52	.377	4.37	.468
70	14490	5.26	.363	6.75	.466	10950	3.87	.353	4.99	.456
75	17330	6.42	.370	8.67	.500	12620	4.20	.333	5.59	.443
80	20450	7.61	.372	10.80	.528	14310	4.50	.314	6.16	.430
85	23690	8.83	.373	13.02	.550	16010	4.80	.300	6.74	.421
90	27290	10.10	.370	15.39	.564	17750	5.08	.286	7.30	.411
95	31300	11.38	.364	17.70	.565	19530	5.36	.274	7.84	.401
100	35530	12.71	.358	20.16	.567	21310	5.64	.265	8.38	.393

1/ Gross Spaulding scale

Table 5.- Redwood log bucking, handsawing.
Total time per cut.

Cut D.i.b.	Peeled trees: Cut time	Peeled trees: Prorata tree time 1/	Unpeeled trees: Cut time	Unpeeled trees: Prorata tree time 1/
Inches	Minutes	Minutes	Minutes	Minutes
15	3.0	2.0	7.5	3.0
20	8.0	3.0	10.5	4.0
25	13.5	4.0	15.0	5.0
30	20.0	5.5	21.5	6.0
35	26.5	7.0	30.5	7.0
40	33.5	9.0	41.0	8.0
45	40.5	11.5	54.0	9.0
50	48.0	14.5	69.0	10.0
55	55.0	17.5	86.5	11.0
60	62.5	21.0	106.0	12.0
65	70.0	24.0	126.5	13.0
70	77.5	27.5	147.5	14.0
75	85.5	31.0	170.0	15.0
80	93.0	34.5	194.0	16.0

1/ Not applied to extra cuts for cull pieces. Cut time applied only to cuts for cull pieces.

PEELING

The cost of peeling sound and goosepen trees, as shown in table 6, is based on timing the peeling of 141 trees. Peeling time per tree varies greatly with the season of the year and the time between felling and peeling. The amount of data available, however, was insufficient to permit analysis by seasonal groups.

Table 7 shows the essential data for building up peeling costs for trees of different length or different percentage peeled. On the study the average amount peeled was 55.1 percent of the total bark on the portion of the tree peeled. The method of paying in this case was on the basis of tree volume. On the area of a neighboring operation where the payment was based on square feet of bark peeled the average percentage peeled was 74.1 percent.

Table 6.- Redwood peeling costs

20 feet diameter O.B.	Sound trees				Goosepen trees			
	Volume	Curved height	Cost per tree	Cost per M	Volume	Curved height	Cost per tree	Cost per M
Inches	Bd.ft.	Feet	Dollars	Dollars	Bd.ft.	Feet	Dollars	Dollars
20	190	30	.222	1.168				
25	700	49	.455	0.650	700	49	.455	.650
30	1380	66	.670	0.486	1380	64	.659	0.478
35	2200	80	.875	0.398	2110	73	.824	0.391
40	3250	92	1.076	0.331	2890	80	.980	0.339
45	4590	102	1.262	0.275	3720	86	1.131	0.304
50	6090	110	1.453	0.239	4890	91	1.284	0.263
55	7630	115	1.662	0.218	6240	96	1.476	0.237
60	9490	120	1.922	0.203	7740	101	1.713	0.221
65	11810	125	2.267	0.192	9330	105	2.026	0.217
70	14490	129	2.641	0.182	10950	107	2.339	0.214
75	17330	132	3.075	0.177	12620	110	2.727	0.216
80	20450	135	3.609	0.176	14310	112	3.196	0.223
85	23690	137	4.197	0.177	16010	113	3.693	0.231
90	27290	139	4.865	0.178	17750	115	4.293	0.242
95	31300	142	5.631	0.180	19530	116	4.943	0.253
100	35530	144	6.433	0.181	21310	118	5.662	0.266

Table 7.- Redwood peeling

20 feet diameter O.B.	Length[1/] peeled: study trees	Surface area: per foot of length	Cost per square foot peeled
Inches	Feet	Sq.ft.	Dollars
20	16.0	5.00	.00360
25	37.8	5.60	.00334
30	58.5	6.27	.00308
35	76.1	7.04	.00287
40	88.9	7.86	.00273
45	99.1	8.71	.00261
50	107.7	9.59	.00252
55	114.7	10.49	.00250
60	119.3	11.40	.00256
65	122.3	12.33	.00269
70	124.5	13.27	.00284
75	126.2	14.33	.00300
80	127.5	15.55	.00319
85	128.7	16.90	.00336
90	129.9	18.36	.00354
95	130.9	19.88	.00373
100	131.9	21.45	.00391

Corrections for deviation from average study length

Deviation in length from average study length[1/]	Correction in cost
Percent	Percent
-70	+51.3
-60	+41.8
-50	+32.8
-40	+24.0
-30	+15.4
-20	+18.0
-10	+ 3.8
0	0
+10	- 3.5
+20	- 6.9
+30	-10.2
+40	-13.5
+50	-16.4
+60	-19.0
+70	-21.3
+80	-23.6

1/ Excluding stump

YARDING

The yarding costs with R. D. 8 tractor and Willamette Hyster arch are shown in table 8 by log volume, in table 9 by tree size. Tractor roads were built by bulldozers. Each tractor made up its own load.

Table 8.- Redwood yarding cost by log volume
R. D. 8 Tractor and Willamette Arch

Gross log volume Spaulding	1000 feet external distance	2000 feet external distance
Board feet	Cost per M	
250	$ 2.411	$ 2.539
500	1.346	1.470
750	.985	1.106
1000	.807	.924
1500	.629	.743
2000	.542	.651
2500	.491	.598
3000	.467	.571
4000	.496	.597
5000	.538 1/	.633 1/
6000	.564 1/	.658 1/

1/ Extrapolation

Table 9.- Redwood yarding costs by tree size.

20 feet diameter O.B.	Sound redwood					Goosepen trees				
		1000 feet external distance		2000 feet external distance			1000 feet external distance		2000 feet external distance	
	Volume	Total cost	Cost per M	Total cost	Cost per M	Volume	Total cost	Cost per M	Total cost	Cost per M
Inches	Bd.ft.	Dollars	Dollars	Dollars	Dollars	Bd.ft.	Dollars	Dollars	Dollars	Dollars
20	190	.46	2.421	.50	2.632					
25	700	.82	1.171	.92	1.314	700	1.21	1.729	1.33	1.900
30	1380	1.25	.906	1.42	1.029	1380	1.42	1.029	1.58	1.145
35	2200	1.72	.782	1.99	.905	2110	1.65	.782	1.88	.891
40	3250	2.25	.692	2.62	.806	2890	1.94	.671	2.28	.789
45	4590	2.83	.617	3.34	.728	3720	2.38	.640	2.80	.753
50	6090	3.49	.573	4.15	.681	4890	2.94	.601	3.42	.699
55	7630	4.15	.544	4.98	.653	6240	3.57	.572	4.28	.686
60	9490	4.91	.517	5.89	.621	7740	4.20	.543	5.12	.661
65	11810	5.90	.500	7.03	.595	9330	4.78	.512	5.79	.621
70	14490	7.11	.491	8.53	.589	10950	5.29	.483	6.34	.579
75	17330	8.68	.501	10.33	.596	12620	5.68	.450	6.82	.540
80	20450	10.48	.512	12.35	.604	14310	6.04	.422	7.28	.509
85	23690	12.43	.525	14.64	.618	16010	6.36	.397	7.73	.483
90	27290	14.57	.534	17.14	.628	17750	6.67	.376	8.17	.460
95	31300	17.00	.543	20.01	.639	19530	6.98	.357	8.61	.441
100	35530	19.53	.550	23.12	.651	21310	7.28	.342	9.04	.424

TRANSPORTATION

Trucks connected by tongue, rather than the usual flat cars were used for rail transportation on this operation. Transportation costs for logs are shown in table 10 and for trees in table 11. The costs per M for transportation have a peculiar trend which is due in large part to the fact that the log length decreases markedly with increase in diameter and to the use of trucks which prevents the loading of short logs end to end as is done on flat cars.

Table 10.- Redwood railroad transportation cost - based on cost of $1.00 per car.

Log d.i.b.	Log volume	Curve value: Total cost	Curve value: Cost per M
Inches	Bd.ft.	Dollars	Dollars
10	335	.060	.179
15	470	.084	.179
20	760	.136	.179
25	1120	.200	.179
30	1530	.272	.178
35	1920	.352	.183
40	2240	.436	.195
45	2500	.572	.229
50	2700	.742	.275
55	2930	.891	.304
60	3260	.964	.296
65	3730	.996	.267
70	4290	1.000	.233
75	4930	1.000	.203
80	5600	1.000	.179

Table 11.- Redwood railroad transportation cost based on cost of $1.00 per car.

20 feet diameter O.B.	Sound redwood trees			Goosepen trees		
	Volume	Tree cost	Cost per M	Volume	Tree cost	Cost per M
Inches	Bd.ft.	Dollars	Dollars	Bd.ft.	Dollars	Dollars
20	190	.05	.263			
25	700	.13	.186	700	.22	.314
30	1380	.24	.174	1380	.26	.188
35	2200	.39	.177	2110	.36	.171
40	3250	.59	.182	2890	.52	.180
45	4590	.86	.187	3720	.74	.199
50	6090	1.20	.197	4890	1.00	.204
55	7630	1.60	.210	6240	1.36	.208
60	9490	2.05	.216	7740	1.76	.227
65	11810	2.54	.215	9330	2.06	.221
70	14490	3.06	.211	10950	2.32	.212
75	17330	3.61	.208	12620	2.55	.202
80	20450	4.16	.203	14310	2.76	.193
85	23690	4.74	.200	16010	2.96	.185
90	27290	5.32	.195	17750	3.15	.177
95	31300	5.92	.189	19530	3.52	.171
100	35530	6.53	.184	21310	3.52	.165

INDEX CURVES OF TREE COSTS

In order to make the tree costs more readily compared with different operations or more readily brought up to date they have been converted to index values based on an average cost of $1.00 per M. The index values are shown in tables 12 and 13, and in figures 1, 2, 3, and 4.

In applying index values the average cost of the operation per M net scale, is converted to average cost per M gross scale. The index values are multiplied by the ratio of the average cost per M gross scale to $1.00. These values are converted into net cost by dividing by 70 percent (sound volume according to Humboldt scale) or by any other appropriate value.

Final tree costs are arrived at by multiplying net cost per M by net volume or by multiplying gross cost per M by gross volume.

In applying these index values it must be assumed that the distribution of trees by diameter is much the same as in the stand from which the tables were prepared (table 14) and if total tree costs are calculated the average volume by tree diameter is approximately the same.

Table 12.- Redwood logging index costs per thousand
Average cost per thousand - $1.00.

Goosepen trees

20 feet diameter O.B.	Felling	Peeling	Bucking		Tractor yarding and loading[1/]		Railroad transportation	Average gross scaled volume
			Peeled	Unpeeled	1000 feet	2000 feet		
Inches	Cost per M feet							Bd.ft.
25	0.886	2.557	1.357	1.757	2.943	2.743	1.586	700
30	1.159	1.877	1.094	1.167	1.754	1.652	.949	1380
35	1.175	1.536	1.009	.967	1.336	1.284	.862	2110
40	1.073	1.332	1.003	.903	1.145	1.138	.910	2890
45	.960	1.196	1.059	.952	1.091	1.086	1.005	3720
50	.804	1.033	1.096	1.029	1.027	1.008	1.033	4890
55	.680	.929	1.177	1.130	.976	.989	1.101	6240
60	.584	.871	1.186	1.138	.926	.953	1.149	7740
65	.515	.854	1.117	1.113	.875	.895	1.116	9330
70	.464	.840	1.046	1.082	.824	.834	1.070	10950
75	.426	.849	.984	1.051	.767	.779	1.021	12620
80	.394	.878	.931	1.023	.721	.734	.975	14310
85	.369	.907	.888	1.000	.678	.697	.935	16010
90	.345	.951	.847	.976	.641	.663	.896	17750
95	.326	.995	.813	.953	.610	.636	.864	19530
100	.310	1.044	.783	.933	.582	.612	.834	21310

1/ May be used for both combined or each separately.

Table 13.- Redwood logging index costs per thousand

Average cost per thousand - $1.00.

Sound redwood trees

20 feet diameter O.B.	Felling	Peeling	Bucking		Tractor yarding and loading[1/]		Railroad transportation	Average gross scaled volume
			Peeled	Unpeeled	1000 feet	2000 feet		
Inches	Cost per M feet							Bd.ft.
20	6.421	4.579	.474	1.263	4.105	3.790	1.316	190
25	2.329	2.557	.671	.843	2.000	1.900	.943	700
30	1.587	1.906	.797	.816	1.543	1.485	.877	1380
35	1.295	1.564	.845	.809	1.336	1.304	.895	2200
40	1.126	1.302	.883	.812	1.182	1.163	.917	3250
45	1.022	1.081	.935	.854	1.052	1.050	.948	4590
50	.977	.938	.972	.905	.979	.984	.995	6090
55	.966	.857	1.025	.956	.928	.941	1.059	7630
60	.998	.797	1.039	.991	.883	.896	1.092	9490
65	1.014	.754	1.048	1.036	.853	.859	1.087	11810
70	1.017	.716	1.074	1.106	.837	.849	1.067	14490
75	1.014	.698	1.097	1.188	.855	.860	1.052	17330
80	1.004	.694	1.102	1.254	.874	.871	1.028	20450
85	1.002	.696	1.103	1.305	.895	.891	1.011	23690
90	.987	.701	1.094	1.338	.910	.905	.984	27290
95	.965	.707	1.075	1.341	.925	.921	.954	31300
100	.941	.712	1.057	1.345	.937	.937	.927	35530

1/ May be used for both combined or each separately.

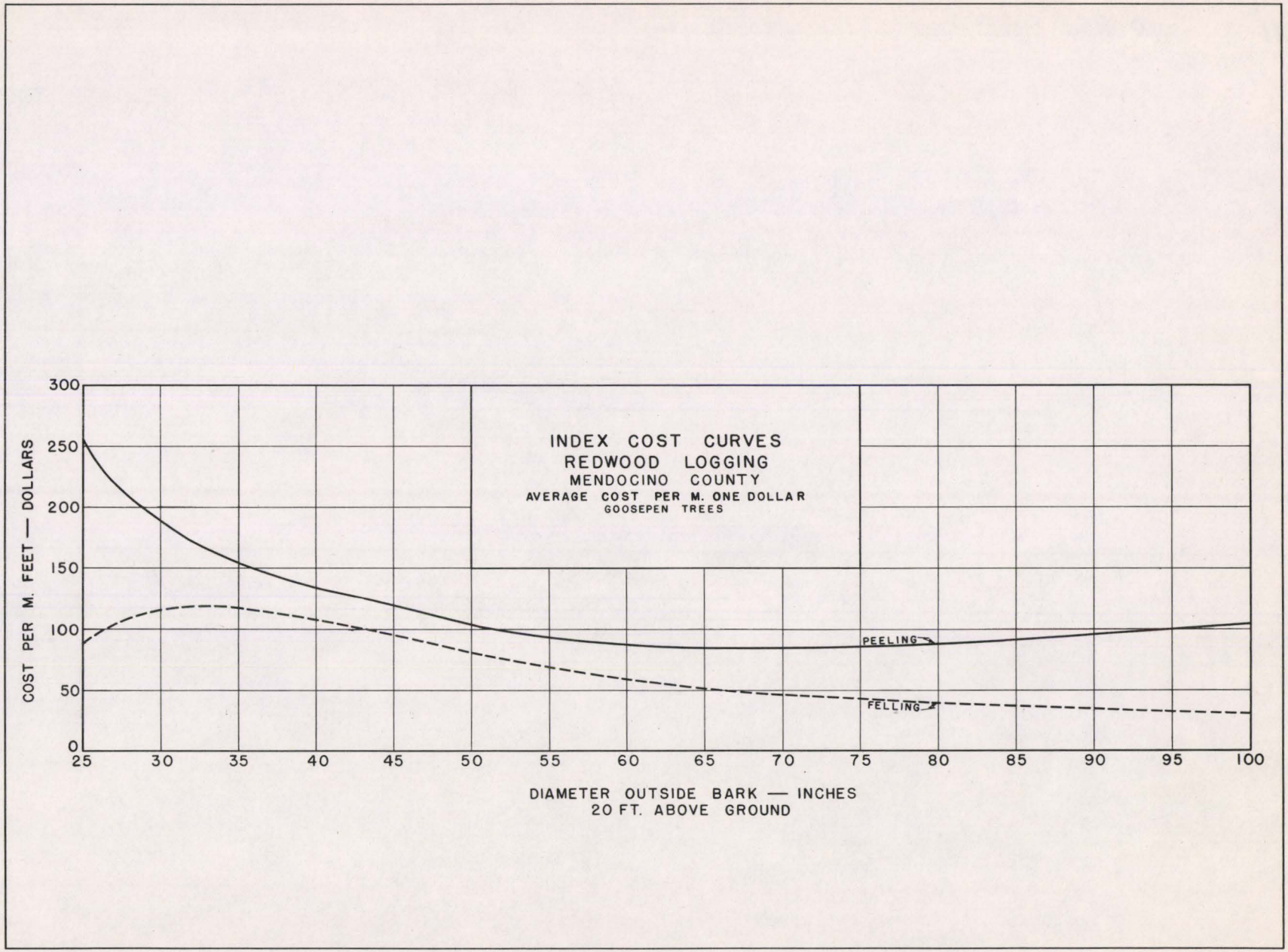
INDEX COST CURVES
REDWOOD LOGGING
MENDOCINO COUNTY
AVERAGE COST PER M. ONE DOLLAR
GOOSEPEN TREES
COST PER M. FEET — DOLLARS
300
250
200
150
100
50
0
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
PEELING
FELLING
DIAMETER OUTSIDE BARK — INCHES
20 FT. ABOVE GROUND

Figure 1.

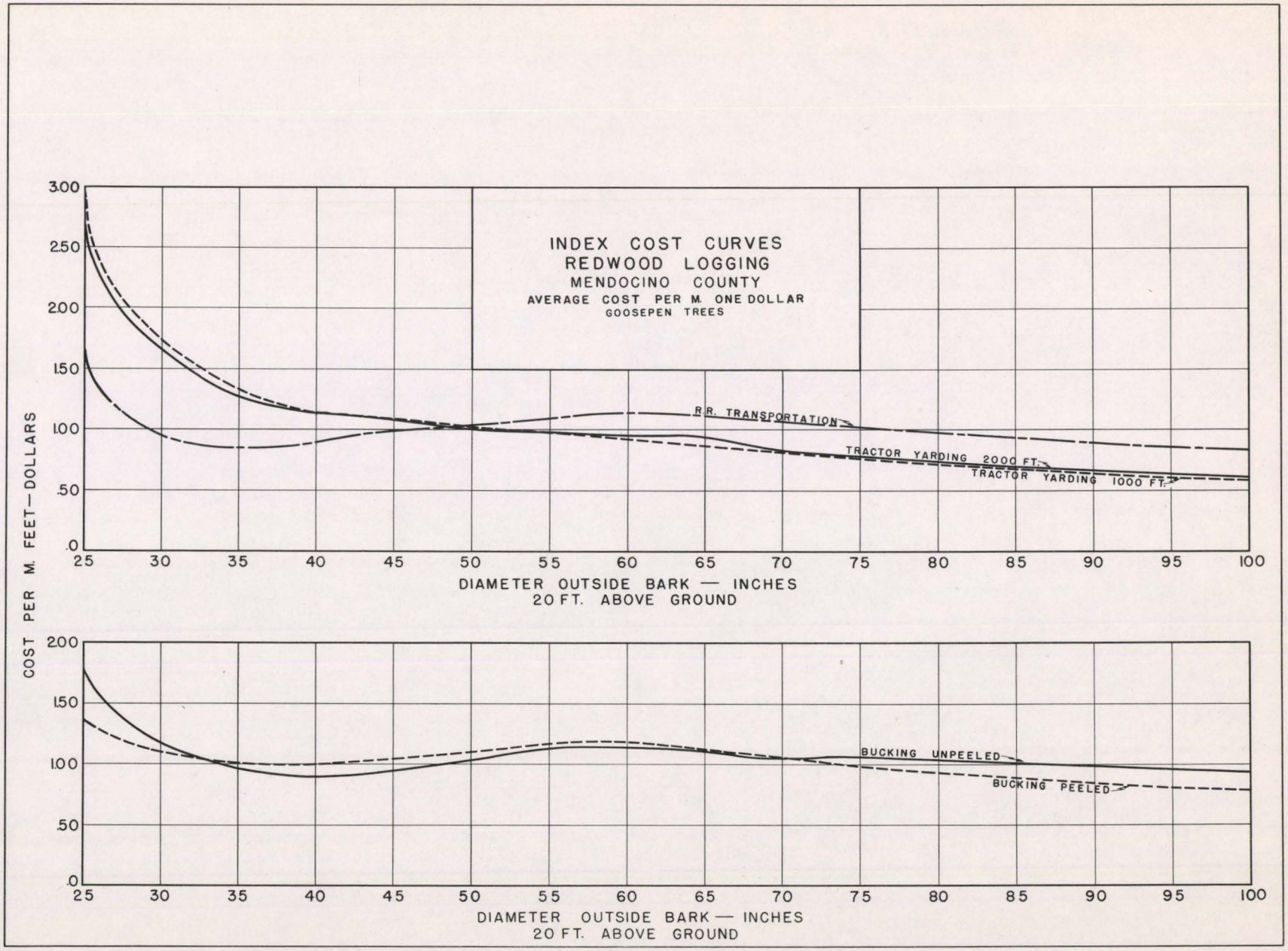
INDEX COST CURVES
REDWOOD LOGGING
MENDOCINO COUNTY
AVERAGE COST PER M. ONE DOLLAR
GOOSEPEN TREES
COST PER M. FEET—DOLLARS
3.00
2.50
2.00
1.50
1.00
.50
.0
R.R. TRANSPORTATION
TRACTOR YARDING 2000 FT.
TRACTOR YARDING 1000 FT.
25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
DIAMETER OUTSIDE BARK — INCHES
20 FT. ABOVE GROUND
2.00
1.50
1.00
.50
.0
BUCKING UNPEELED
BUCKING PEELED
25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
DIAMETER OUTSIDE BARK — INCHES
20 FT. ABOVE GROUND

Figure 2.

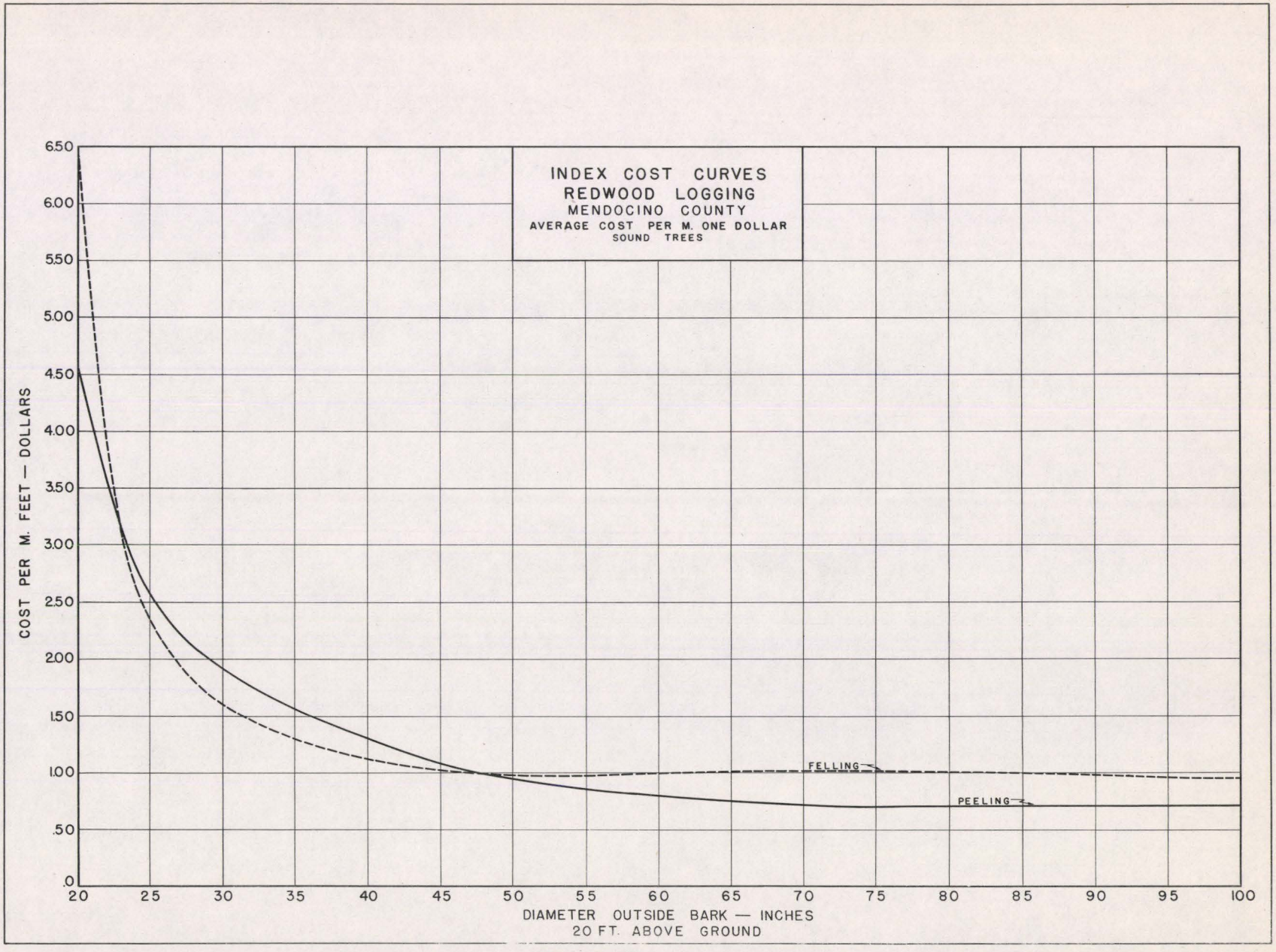
INDEX COST CURVES
REDWOOD LOGGING
MENDOCINO COUNTY
AVERAGE COST PER M. ONE DOLLAR
SOUND TREES
COST PER M. FEET — DOLLARS
6.50
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
.50
.0
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
DIAMETER OUTSIDE BARK — INCHES
20 FT. ABOVE GROUND
FELLING
PEELING

Figure 3.

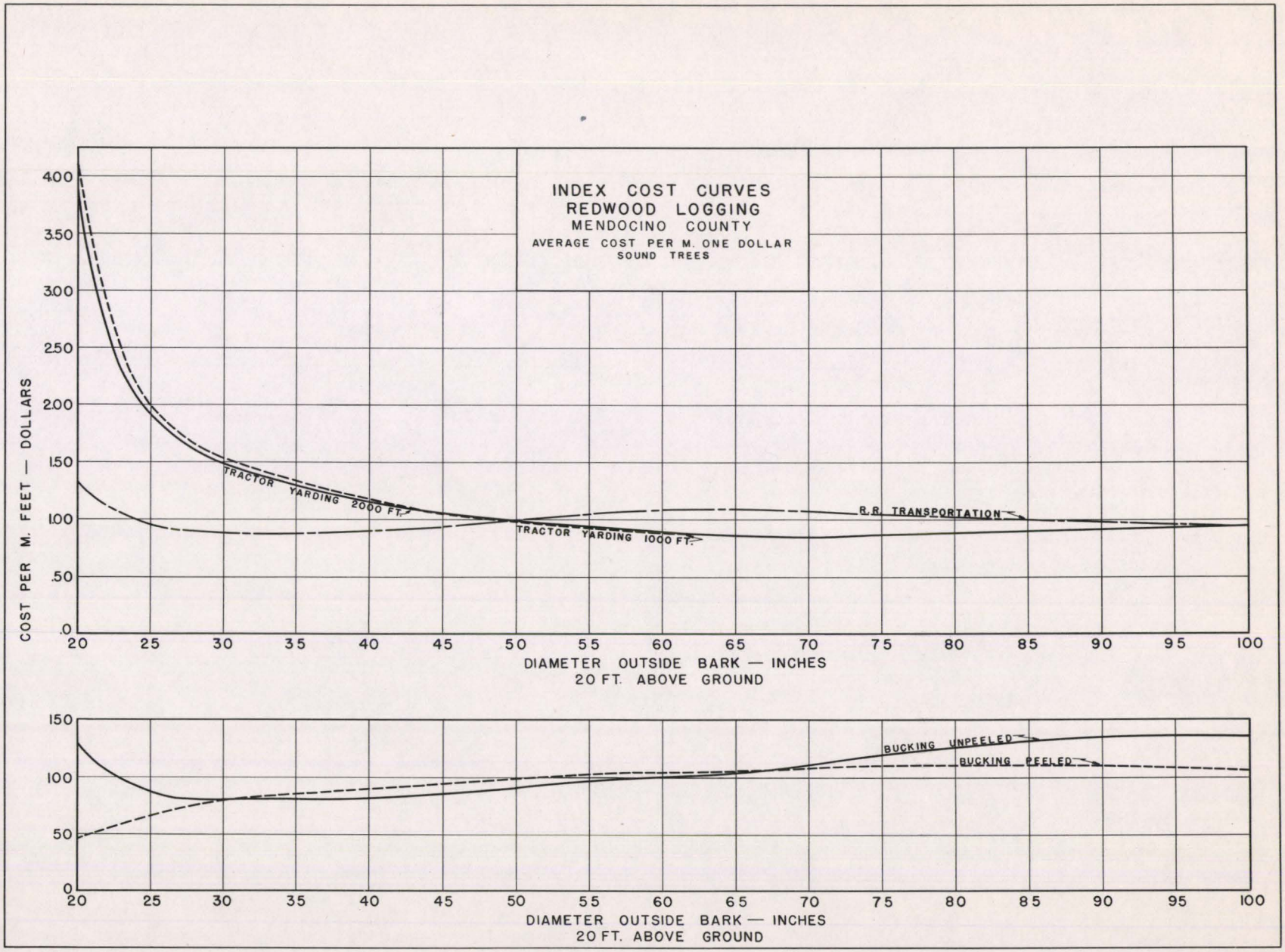
INDEX COST CURVES
REDWOOD LOGGING
MENDOCINO COUNTY
AVERAGE COST PER M. ONE DOLLAR
SOUND TREES
COST PER M. FEET — DOLLARS
4.00
3.50
3.00
2.50
2.00
1.50
1.00
.50
.0
TRACTOR YARDING 2000 FT.
TRACTOR YARDING 1000 FT.
R.R. TRANSPORTATION
20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
DIAMETER OUTSIDE BARK — INCHES
20 FT. ABOVE GROUND
150
100
50
0
BUCKING UNPEELED
BUCKING PEELED
20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
DIAMETER OUTSIDE BARK — INCHES
20 FT. ABOVE GROUND

Figure 4.